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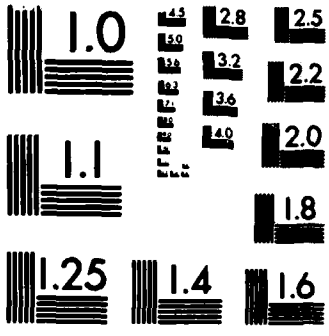

ASSESSING THE HEALTH RISKS OF CARRIER LANDINGS IN U. S. NAVY PILOTS

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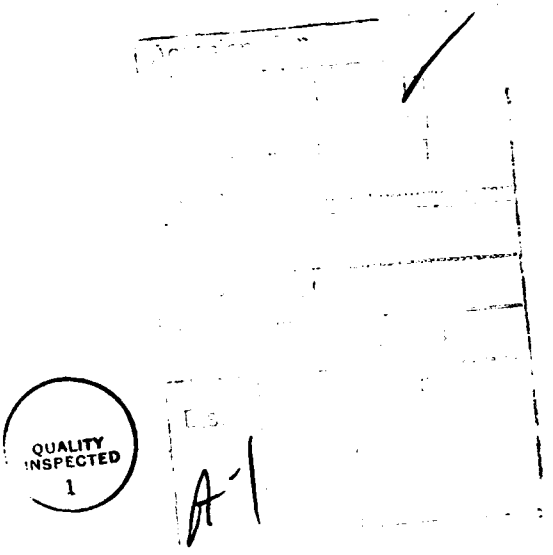

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SUMMARY

Problem

Landing an airplane on an aircraft carrier is one of the most demanding and complex tasks required of Navy pilots. Heart rate values in pilots increase during flight, especially during landings and launch. Because of the hazards involved, carrier landings might have an impact on the health of Navy pilots.

Objectives

This study was designed to determine whether or not carrier landings adversely affected the health of Navy pilots. The objective was to compare the hospitalization and mortality rates of helicopter pilots and fixed-wing pilots who had considerable carrier landing experience with a control group of pilots who had little, if any, carrier landing experience.

Approach

The pilot population was identified from the Individual Flight Activity Reporting System file which was provided to the Naval Health Research Center by the Naval Safety Center in Norfolk, VA. Data extracted from this file included birth year, first and last years of flying, total pilot hours, aircraft models flown, and number of day and night carrier landings. Selection of participants was accomplished by matching the birth years of pilots who primarily flew helicopters and who had 150 or more carrier landings (n = 2,099) with those of pilots of fixed-wing aircraft models who also had 150 or more carrier landings (n = 2,099). A like number of pilots with 25 or fewer carrier landings and identical birth years was selected as a control sample. Hospitalization and death data extracted from the Medical Inpatient file included hospital admission dates, diagnoses, and injury and death cause codes. During the period from July 1967 through December 1979, annual hospitalization rates per 10,000 pilot strength were computed for 14 major diagnostic categories and several selected subcategories for each of the three pilot groups. Annual mortality rates per 10,000 strength also were computed. Ninety-five percent confidence limits were compared across the three samples to determine whether or not hospitalization and mortality rates differed significantly.

Results

Results of comparisons across carrier landing exposure groups revealed no significantly higher total hospitalization rate for any one of the three groups. The two groups with considerable carrier landing experience had significantly higher rates than controls for the category of supplementary classifications although no specific diagnosis differentiated among the three groups. Pilots of fixed-wing models had a significantly higher hospitalization rate than controls for on-duty aviation-related accidental injuries as well as a significantly higher rate than helicopter pilots for back disorders. Helicopter pilots were observed to have a significantly higher hospitalization rate than controls for ulcers. The fixed-wing pilot group had a significantly higher mortality rate than helicopter pilots; all of these deaths, except one, were for aviation-related reasons.

Conclusions

Results indicated that pilots who had considerable carrier landings experience were at increased risk for ulcers (in helicopter pilots) and back disorders and aviation-related accidental injuries (in fixed-wing pilots) whereas control pilots did not have higher hospitalization or mortality rates for any specific diseases or types of injury. The factors of prior accidents, age, and flying experience in fixed-wing pilots were shown to have little, if any, effect on injury or mortality rates. The higher rate of back disorders in fixed-wing pilots may be associated with the impact on the back and spinal column of hundreds of carrier landings. The higher rate of ulcers in helicopter pilots might be a manifestation of the unique stressors to which they are subjected.

Recommendations

Future research will be designed to assess the contributions of carrier landings, other operational factors, and demographic variables as correlates of morbidity, mortality, disability, and attrition. Results of this series of studies will provide the aviation and medical communities with needed information on the health risks associated with the profession of U.S. Navy pilots.

Assessing the Health Risks of Carrier Landings in U.S. Navy Pilots

During the past 20 years, numerous studies were conducted that assessed the health effects of various occupational stressors. Probably the most frequently cited research was that on air traffic controllers who were reported to have an elevated risk of developing such stress-related diseases as hypertension, peptic ulcers, and diabetes mellitus (3). This increased risk was postulated to be related to working in high traffic density control towers.

Research results reported on a U.S. Navy officer population showed that pilots and aircrew officers had higher total hospitalization rates than Staff Corps and nonaviation unrestricted line officers (7). The frequent monitoring of pilots' health status probably contributed to their higher rates because any irregularities detected by the flight surgeon could result in an immediate hospitalization; other officers may be less closely scrutinized by medical personnel, and the prescribed treatment more often may be delivered at an outpatient facility.

In order to identify stressors that may influence the health status of pilots, several occupational factors have been examined. For example, studies on the type of aircraft model primarily flown revealed an increased incidence of lumbosacral pain and sciatica in helicopter pilots (5,15) and higher hospitalization rates for several diagnostic categories in young trainer pilots (6).

The effects of acceleration and G loadings on pilots' health status also received considerable research attention, as reported in a review article by Voge (17). Other research showed that combat pilots had significantly higher total hospitalization rates than noncombat pilots during a time period of more than a decade after combat (8). No specific disease, however, was identified that differentiated combat from noncombat pilots.

Aircraft carrier landings also were considered a stressor that could impact on pilots' health. Landing an airplane on a carrier is one of the most demanding and complex tasks required of naval aviators (1,11,14). Roscoe (13) and Lindholm and Cheatham (10) determined that heart rate values increased during flight, especially during takeoffs and landings; in fact, Roman and his associates (12) monitored highly experienced pilots and reported that heart rates were higher during landings and launch than during actual combat. Although heart rates rose during carrier launch and recovery operations, no significant differences were noted between day or night landings (13).

The purpose of this study was to determine whether or not carrier landings adversely affected the health of Navy pilots. Specifically, this study was designed to examine the hospitalization and mortality rates of three groups of pilots who were matched on birth year: helicopter pilots with 150 or more carrier landings, pilots of fixed-wing aircraft models who had 150 or more carrier landings, and a control sample of pilots who had 25 or fewer carrier landings.

DATA AND METHODS

Study population: The pilot population for this study was identified from the Individual Flight Activity Reporting System (IFARS) file which was provided to the Naval Health Research Center by the Naval Safety Center in Norfolk, Virginia. Information extracted from this file

consisted of birth year, first and last years of flying, total pilot hours, aircraft models flown, and the number of day and night carrier landings.

The first pilot group selected included 2,099 U.S. Navy pilots who primarily flew helicopters and who had 150 or more aircraft carrier landings. Birth years were matched with those of all other pilots to extract a sample of 2,099 pilots who also had 150 or more carrier landings but primarily in fixed-wing models. A like number of pilots with 25 or fewer carrier landings and identical birth years was selected as a control group for the other two cohorts. The mean birth year for each group was 1944, and the median rank was lieutenant commander. Mean total flight hours as a first pilot or copilot were 2,205.4 for controls, 2,376.5 for helicopter pilots, and 2,598.1 for fixed-wing pilots. Overall mean numbers of combat hours tended to be quite low for this pilot subpopulation: 65.6 for controls, 113.0 for helicopter pilots, and 143.2 for fixed-wing pilots. While the differences in these means suggest the possibility of an effect on health, results of a study on hospitalizations of combat pilots identified no specific disease attributable to combat experience (8). Moreover, the combat pilot population ($\underline{n}$ = 5,835), which excluded repatriated prisoners of war, had considerably more combat experience ($\bar{X}$ = 319.7 combat hours) than pilots included in the present study. The mean numbers of carrier landings was 6.6 for controls, 340.4 for fixed-wing pilots, and 442.9 for helicopter pilots.

Procedure: Hospitalization information for the 6,297 pilots was extracted from the Medical Inpatient file which is maintained at the Naval Health Research Center. The following data were selected for each hospitalization: admission date; primary, secondary, and tertiary diagnoses; and injury cause code. Injury and death cause codes were examined to identify the specific circumstances of the incident (e.g., an on-duty, aviation-related injury or off-duty, sports-related injury).

Annual hospitalization rates per 10,000 strength were determined after tabulating the frequencies of hospitalizations and computing the number of person-years at risk during the 12.5 years of this study (July 1967 to December 1979). Person-years at risk for the three groups were obtained by computing the number of pilots on active duty for each year and then summing these totals across the specified time period. For example, if a pilot served on active duty from 1970 through 1979, he would contribute 10 person-years to the total. The diagnostic nomenclature used in this study was based on the Eighth Revision of the International Classification of Diseases Adapted for Use in the United States (ICDA-8). To ascertain whether or not significant differences existed across groups, 95% confidence limits were computed and compared for each major diagnostic category and several specific diagnoses. Similarly, annual mortality rates per 10,000 strength and 95% confidence limits were computed. However, because of the lack of complete data for the 1967 to 1973 time period, these rates only were reported for 1974 to 1979.

RESULTS

Hospitalization and mortality rates by pilot group: Results of comparisons across carrier landing exposure groups revealed no significantly higher total hospitalization rate for any one of the three groups (see Table I). The two groups with considerable carrier landing experience, however, had significantly higher rates than controls for the category of supplementary

TABLE I. HOSPITALIZATION RATES PER 10,000 BY DIAGNOSTIC CATEGORY AND TYPE OF EXPOSURE FOR U.S. NAVY PILOTS, JULY 1967-DECEMBER 1979

	Helicopter		Fixed Wing		Control	
Diagnostic Category (ICDA-8)	No.	Rate	No.	Rate	No.	Rate
Accidents, Poisonings, and Violence	118	67.6	126	73.9	74	56.9
On-duty, aviation-related injuries	10	5.7	16	9.4*	1	-
Diseases of the Digestive System	108	61.8	90	52.8	73	56.1
Ulcers	11	6.3*	3	1.8	1	-
Diseases of the Musculoskeletal System	63	36.1	75	44.0	54	41.5
Disorders of the back	18	10.3	38	22.3*	19	14.6
Disorders of the joint	32	18.3	21	12.3	18	13.8
Diseases of the Genitourinary System	55	31.5	65	38.1	39	30.0
Diseases of the Circulatory System	47	26.9	61	35.8	41	31.5
Cardiovascular disease	15	8.6	32	18.8	12	9.2
Diseases of the Respiratory System	54	30.9	38	22.3	35	26.9
Infective and Parasitic Diseases	28	16.0	36	21.1	28	21.5
Symptoms and Ill-defined Conditions	28	16.0	39	22.9	22	16.9
Diseases of the Nervous System	32	18.3	17	10.0	26	20.0
Diseases of the Skin	23	13.2	26	15.2	17	13.1
Mental Disorders	24	13.7	23	13.5	18	13.8
Alcoholism	15	8.6	10	5.9	6	4.6
Neoplasms	23	13.2	21	12.3	20	15.4
Supplementary Classifications	28	16.0**	24	14.1**	6	4.6
Endocrine, Nutritional, and Metabolic Diseases	9	5.2	6	3.5	10	7.7
Total	649	371.7	653	382.8	472	362.8
Person-years at risk	17,459		17,057		13,008	

*The starred group had a significantly higher ($p < .05$) hospitalization rate than the group with the lowest rate. **Both helicopter and fixed-wing pilots who had ≥150 carrier landings had significantly higher ($p < .05$) hospitalization rates than control pilots with ≤25 carrier landings. Rates were not computed for frequencies of less than 3. Rates for the categories of Congenital Anomalies and Diseases of the Blood and Blood-forming Organs were not included in the table, but were in the total.

classifications, but no specific diagnosis (e.g., medical or special examination, medical or surgical aftercare) in this category differentiated among the three groups. Pilots of fixed-wing models had a significantly higher hospitalization rate than controls for on-duty aviation-related accidental injuries as well as a significantly higher rate than helicopter pilots for disorders of the back. Helicopter pilots were observed to have a significantly higher hospitalization rate than controls for ulcers. Although fixed-wing pilots had more than twice the cardiovascular disease rate than the other groups, this difference was not statistically significant.

Rates of mortality ranged from 6.2 per 10,000 for helicopter pilots to 11.8 for controls and 27.0 for fixed-wing pilots. In comparing 95% confidence limits, the fixed-wing pilot group had a significantly higher mortality rate than helicopter pilots. All of the deaths for the fixed-wing pilot group, except one, were for aviation-related reasons.

DISCUSSION

Results of this study indicated that pilots who had considerable carrier landing experience were at higher risk than control pilots for several disorders. Significant differences were observed for mortality rates and hospitalization rates for ulcers, back disorders, on-duty aviation-related injuries, and the diagnostic category of supplementary classifications.

The control group was not distinguished from the other two groups because of higher hospitalization or mortality rates for any specific diseases or types of injury. Helicopter pilots had a higher hospitalization rate than controls for ulcers. Of all diagnoses examined in this study, the higher rate for ulcers was the only one based on comparisons of rates for an illness rather than an injury or musculoskeletal disorder. Considered by some researchers as a stress-related illness (3), this higher rate might be a manifestation of the unique stressors to which helicopter pilots are subjected, such as low-altitude hovers at sea at IFR conditions (16). No other stress-related disorder was determined to be at increased risk for carrier-based pilots, except for the higher hospitalization rate of cardiovascular disease in fixed-wing pilots than the other groups. Differences in rates between groups, however, were not statistically significant.

Fixed-wing pilots had a higher hospitalization rate than controls for on-duty aviation-related injuries. This pilot group also had the highest mortality rate which included 24 (of a total of 25) aviation-related deaths; the vast majority of these deaths occurred because of a forced landing. Such results substantiated other research that reported a higher accident risk in carrier-based than other aviation (1,11,14).

These and previously reported results suggest that consideration should be given to two major factors as potential correlates of aviation-related injuries in fixed-wing pilots: a high risk-taking personality characteristic and the pilot's age and overall level of experience. Levine and his associates (9) reported that pilots who had elevated scores on an "adventurous" scale, which seemed to reflect risk-taking behavior, were more likely than other pilots to experience an aviation mishap. While data on such behaviors were unavailable for pilots in the present study, an examination of <u>all</u> previous accidental injury hospitalizations was conducted in order to determine whether or not a pilot was a probable high accident risk. Among the 24 pilots who died and 16 pilots who had been hospitalized for an aviation-related accidental injury, only two had been hospitalized previously for any type of accidental injury. Extrapolating from these results, it could not be concluded that these pilots were high accident risks.

Age and experience also were examined as factors possibly associated with these aviation-related injuries and deaths. Other researchers reported that younger, inexperienced fighter pilots were more likely than their older, experienced counterparts to be involved in an aviation mishap (2,4). Of the pilots in the present study who were hospitalized for an accidental injury, only one pilot was less than 25 years of age (24), and he was the only pilot who had less than two years of flying experience. The mean age of the hospitalized pilots was 28.6 (from 24 to 36) and the mean number of years of flying experience was 5.8 years (from 1 to 16 years). The ages at the time of death ranged from 27 to 40. Thus, the number of younger, inexperienced pilots involved in an aviation mishap was not shown to be disproportionately high; the age and experience levels of

these pilots were determined to be representative of those for pilots typically assigned to carrier squadrons (9).

An unexpected finding of this study was the significantly higher hospitalization rate of back disorders for fixed-wing pilots as contrasted with the rate for helicopter pilots. Other researchers have reported a relatively high incidence of back symptoms and pain in helicopter pilots which was attributed to the vibration of the aircraft and to the posture that helicopter pilots assumed when operating the aircraft (15). Because there were no cause codes for the subcategory of back disorders, it was impossible to identify those back problems associated with a specific aircraft model or an operational aspect of aviation. An examination of the medical record narrative summaries might provide useful information on the circumstances associated with these hospitalizations. However, for those fixed-wing pilots who were hospitalized for a back disorder, perhaps we can postulate that the impact of hundreds of carrier landings was manifested by injury to the spinal column--and an increased number of hospitalizations for displacement of the intervertebral disc and vertebrogenic pain syndrome. The jolt associated with landing a fixed-wing plane on a carrier might produce wear and tear on the back after several hundred of these landings. These pilots had considerable carrier landing experience, with a mean number of carrier landings of 340.4.

To summarize, the results revealed that pilots with considerable carrier landing experience were at increased risk for ulcers (in helicopter pilots) and back disorders and aviation-related accidental injuries (in fixed-wing pilots). On the basis of these results, subsequent research will be designed to assess the contributions of carrier landings, other operational factors, and demographic variables as correlates of morbidity, mortality, disability, and attrition. Findings of this series of studies will provide the aviation and medical communities with needed information on the health risks associated with the profession of U.S. Navy pilot.

REFERENCES

1. Brictson CA. Analysis of F4 aircraft day and night carrier approaches. Aerospace Med. 1967; 38:1219-24.
2. Borowsky MS, Gaynor J, Barrett G, Beck A. Relationships between U.S. Navy carrier landing accidents and flight experience parameters. Aviat. Space Environ. Med. 1981; 52:109-11.
3. Cobb S, Rose RM. Hypertension, peptic ulcer, and diabetes in air traffic controllers. JAMA 1973; 224: 489-92.
4. Eyraud MY, Borowsky MS. Age and pilot performance. Aviat. Space Environ. Med. 1985; 56:553-8.
5. Gearhart JR. Response of the skeletal system to helicopter-unique vibration. Aviat. Space Environ. Med. 1978; 49:253-6.
6. Hoiberg A. Differences in health risks by aircraft model among U.S. Navy pilots. Aviat. Space Environ. Med. 1985; 56:676-82.
7. Hoiberg A, Blood C. Age-specific morbidity among Navy pilots. Aviat. Space Environ. Med. 1983; 54:912-18.
8. Hoiberg A, Burr RG. Longitudinal study of the health status of U.S. Navy combat pilots. Paper presented at the Aerospace Medical Association Meetings, May 13-16, 1985, San Antonio, TX.
9. Levine JB, Lee JO, Ryman DL, Rahe RH. Attitudes and accidents aboard an aircraft carrier. Aviat. Space Environ. Med. 1976; 47:82-5.
10. Lindholm E, Cheatham CM. Autonomic activity and workload during learning of a simulated aircraft carrier landing task. Aviat. Space Environ. Med. 1983; 54:434-39.
11. Miller RG, Rubin RT, Clark BR, Crawford WR, Arthur RJ. The stress of aircraft carrier landings 1. Corticosteroid responses in naval aviators. Psychosomatic Med. 1970; 32:581-8.
12. Roman J, Older H, Jones WL. Flight research program: VII. Medical monitoring of Navy carrier pilots in combat. Aerospace Med. 1967; 38:133-9.
13. Roscoe AH. Stress and workload in pilots. Aviat. Space Environ. Med. 49:630-6.
14. Rubin RT, Miller RG, Clark BR, Polland RE, Arthur RJ. The stress of aircraft carrier landings II. 3-methoxy-4-Hydroxyphenylglycol excretion in naval aviators. Psychosomatic Med. 1970; 32:589-97.
15. Shanahan DF, Reading TE. Helicopter pilot back pain: A preliminary study. Aviat. Space Environ. Med. 1984; 55:117-21.
16. Tormes FR, Guedry FE. Disorientation phenomena in Naval helicopter pilots. Aviat. Space Environ. Med. 1975; 46:387-93.
17. Voge VM. Acceleration forces on the human subject. Aviat. Space and Environ. Med. 1980; 51:970-80.

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The purpose of this study was to determine whether or not carrier landings adversely affected the health status of U.S. Navy pilots. Matched on birth year, the three groups (n = 2,099 each) included helicopter and fixed-wing pilots who had 150 or more carrier landings and a comparison group of pilots who had less than 26 carrier landings. Results indicated that pilots who had considerable carrier landing experience were at increased risk for ulcers (in helicopter pilots) and back disorders and aviation-related accidental

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injuries (in fixed-wing pilots), whereas control pilots did not have higher hospitalization or mortality rates for any specific diseases or types of injury. The factors of prior accidents, age, and flying experience seemed to have little, if any, effect on these rates. Subsequent research will be designed to assess the contributions of carrier landings, other operational factors, and demographic variables as correlates of pilots' morbidity, mortality, disability, and attrition.

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